THE UNIVERSITY *of* TULSA

Department of Petroleum Engineering

DRILLING RESEARCH PROJECTS
ADVISORY BOARD MEETING
November 9th, 2009

EXECUTIVE SUMMARIES

AGENDA

THE UNIVERSITY OF TULSA
Drilling Research Projects
Advisory Board Meeting

The DoubleTree Hotel at Warren Place
6110 S. Yale Avenue
Tulsa, OK 74136

AGENDA

Monday, November 9th , 2009

CLASSIC CONTINENTAL BREAKFAST……………………………………………………..8:00 a.m.
The DoubleTree Hotel at Warren Place
Tulsa Learning Theater

INTRODUCTION
Stefan Miska …………………………………………….……………………8:30 a.m. – 8:50 a.m.

PROGRESS REPORTS

Reza Majidi...…………...……… ….………….……………………………...8:50 a.m. – 9:25 a.m.
    Fingerprint Losses into Natural or Induced Fractures

Yongfeng Kang …………………………………………….…...…….…..…….9:25 a.m. – 9:50 a.m.
    Study of Modeling Transient Borehole Failure Using Discrete Element Method

Tan Nguyen...…………….……………………….……...…….……...……9:50 a.m. – 10:20 a.m.
    Predicting Dynamic Barite Sag in Oil Based Drilling Fluids

Coffee Break …………………………………….…...…….…………..10:20 a.m.- 10:40 a.m.

Duc Nguyen …………………………………….……...……..…….…….10:40 a.m.- 11:10 a.m.
    Modeling Thermal Effects on Wellbore Stability

Jiafu Xu …………………………………………..…………….……..…...11:10 a.m.- 11:35 a.m.
    *Cuttings Transport with Foam at Simulated Downhole Conditions- The Effect of Hole
    Inclination Angle*

Sandeep Tammineni …………………………….……..……………...11:35 a.m.- 12:00 p.m.
    The Effect of Depth of Cuts and RPM on Mechanical Specific Energy

LUNCH…………………...12:00 p.m. - 1:15 p.m.
Parkview Ballroom

INDUSTRY PRESENTATION

Fred Growcock – MI-SWACO………………………………………...1:15 p.m. – 1:55 p.m.
"How to Stabilize and Strengthen the Wellbore during Drilling Operations"

PROGRESS REPORTS

Lu Huang …………………………………..……………….………1:55 p.m.- 2:20 p.m.
     Shale Stability at Simulated Wellbore Conditions

Muzaffer Gokdemir …………………………………….…….…..………...2:15 p.m.- 2:40 p.m.
     Experimental Study on Gelation Phenomena of Synthetic Drilling Fluids

Georges Ishak…..……………………………………………….….………2:40 p.m.- 3:05 p.m.
     Modeling and Simulation of Simultaneous Drilling and Underreaming

Coffee Break   ……………………………………………….…….……….3:05 p.m.- 3:25 p.m.

Amar Vankadari…….………………………………….…….…..……….3:25 p.m.- 3:50 p.m.
     Experimental Study of Torque Reduction Additives for Extended Reach Drilling

NEW RESEARCH PROPOSAL

Yahya Hashemian…………….……………………………………….3:50 p.m.- 4:05 p.m.
     Experimental Study and Modelling of Barite Sag in Annular Flow

Vusal Rajabov…….……………………………………………..4:05 p.m.- 4:20 p.m.
     Study of the Factors Affecting MSE: The Effects of Back Rake and Side Rake Angles

Duc Nguyen…….…………………………………………..4:20 p.m.- 4:35 p.m.
     Smear Effect in Casing Drilling-The Effect of Casing Dynamics

Mengjiao Yu / Yuanhang Chen………….…………………………..4:35 p.m.- 4:50 p.m.
    Update on Current Research Projects

Budget and Closing Comments …………….…………………......…....4:50 p.m. – 5:00 p.m.

RECEPTION………………………………………………………7:00 p.m – 9:00 p.m.
     The DoubleTree Hotel at Warren Place – Parkview Ballroom
     6110 S. Yale Avenue
     Tulsa, OK 74136

THE UNIVERSITY OF TULSA
Advisory Board Meeting

University of Tulsa
2450 E Marshall
Tulsa, OK 74110

AGENDA

Tuesday, November 10th, 2009 NORTH CAMPUS

All Visitors Assemble in Drill Building Conference Room……………….……………..9:00 a.m.

Reza Majidi & Nicholas Takach……………………………………….…9:05 a.m. - 9:20 a.m.
   Tour Schedule & Facility Improvements

FACILITY TOUR of NORTH CAMPUS...9:20 a.m. – 11:00 a.m.

ROUND TABLE DISCUSSION…………………………………………..11:00 a.m. – 11:30 a.m.

LUNCH………………………………………………………………………… 11:45 p.m.-1:00 p.m.
The University of Tulsa South Campus- Gallery

INDIVIDUAL MEETINGS (upon request**).**………………………………………1:30 p.m. – 5:00 p.m.

*********Next Advisory Board Meeting- May 10th and 11th , 2010***********
         Doubletree Warren Place Hotel- Tulsa

MEMBER COMPANIES

ChevronTexaco	**1967**
BP Exploration	**1977**
Petrobras/Cenpes	**1984**
StatoilHydro	**1985**
Halliburton Energy Services	**1996**
Baker-Hughes	**1997**
Schlumberger	**1997**
Weatherford	**2000**
ExxonMobil	**2002**
ConocoPhillips	**2003**
Smith International/MI-SWACO	**2006**
Shell E&P	**2007**
VAM Drilling France	**2007**
Reed Hycalog/Grant Prideco	**2007**
Minerals Management Service	**2008**
ENI	**2008**
Det norske oljeselskap ASA	**2009**

TUDRP PERSONNEL

TUDRP PERSONNEL

EXECUTIVE DIRECTOR/ PRINCIPAL INVESTIGATOR:
Stefan Miska

SENIOR ASSOCIATE DIRECTOR:
Nicholas Takach

ASSOCIATE DIRECTOR:
Mengjiao Yu

ASSOCIATE DRILLING FACULTY:
Evren Ozbayoglu

RESEARCH ASSOCIATE:
Reza Majidi

PROJECT ASSISTANT:
Paula Udwin

PROJECT TECHNICIAN:
Randy Darden
Don Harris

RESEARCH CONSULTANTS:

Charles Alworth	JJ Azar
Jeremy Daily	Siamack Shirazi
Jim Sorem	Steven Tipton

UNDERGRADUATE TECHNICIAN ASSISTANTS:
Robert Darden   Charles Patrick   Jonathan Shim   Elmer Bachtiar

RESEARCH ASSISTANTS:

Yuanhang Chen, M.S. Candidate	Vusal Rajabov, M.S. Candidate
Muzaffer Gokdemir, M.S.Candidate	Sandeep Tammineni, M.S. Candidate
Yongfeng Kang Ph.D. Candidate	Amar Vankadari, M.S. Candidate
Duc Nguyen, Ph.D. Student	Jiafu Xu, M.S. Candidate
Lu Huang, M.S. Candidate	Georges Ishak M.S. Candidate
Yahya Hashemian Adariani Ph.D. Student	Tan Nguyen, Ph.D.

Shipping Address:	**Mailing Address:**
University of Tulsa	University of Tulsa
Drilling Research Projects	Drilling Research Projects
2450 East Marshall Street	600 South College Avenue
Tulsa, Oklahoma 74110	Tulsa, Oklahoma 74104
Telephone: (918) 631-5171	**FAX:** (918) 631-5009

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Fingerprint Losses into Natural or Induced Fractures

Reza Majidi

Modeling of Drilling Fluid Losses in Fractured Formations

INVESTIGATOR: Reza Majidi

SPONSOR: TUDRP

OBJECTIVE:
- To develop mathematical models for fluid losses in fractured formations.
- To distinguish between natural and induced fractures from the behavior of mud losses.
- Quantitative analysis of drilling fluid losses in order to characterize the fractures.

PAST WORK:
- Development of mathematical modeling for Yield-Power-Law fluid losses in natural fractures. The effect of drilling fluid rheology on minimizing the losses was studied.
- Including the effect of formation fluid and fluid leak-off in the model for YPL fluid.
- Analysis of field case studies of two mud lost events.
- Experimental study of radial flow of YPL fluids between parallel plates to simulate the losses in a single fracture.

CURRENT WORK:
- Continue of the modeling in order to distinguish between induced and natural fractures.
- Development of mathematical model for drilling induced fractures.

FUTURE WORK
- Examine the validity of the provided model by field data. (if available)

DELIVERABLES
- Computer program/ Spread sheet which allows for analysis of mud losses in fractures.
- Semi-annual Advisory Board Meeting (ABM) reports and the Final Report.

PROJECT STATUS:

Tasks	2009						2010						
	2	4	6	8	10	12	2	4	6	8	10	12	
Literature Review	×	×	×	×	×	×							80%
Mathematical Modeling			×	×	×	×							70%
Computer Simulations				×	×	×							50%
Field Data Analysis													00%
Final Report													00%

Modeling of Transient Borehole Failure Using Discrete Element Method

Yongfeng Kang

Modeling Transient Borehole Failure Using Discrete Element Method

INVESTIGATOR: Yongfeng Kang

OBJECTIVES:
- To develop an understanding of transient borehole failure;
- To predict transient borehole failure by modeling rock behavior at the grain level using the discrete element method;
- To develop a computer program to simulate the transient borehole failure at simulated downhole conditions;
- To verify the model with field data or published data if available.

STATUS OF PROJECT:

Task	Description	Percentage completed
Literature review	Traditional models	100%
	DEM	90%
Mathematical modeling of DEM	For 2D case	95%
Computer Simulator Development	For 2D case	100%
Verification and Improvement	For 2D case	50%
Final report		--%

RECENT PROGRESS:

- A visualization tool was modified based on an open-source project, so the simulation results could be visualized and analyzed with this tool now;
- Multi-threading technology was adopted, and speed was improved 2~3 times faster. It is believed that there is still room to improve the computing speed with a better parallel program structure;
- Simulations were conducted to investigate the wellbore stability of unconsolidated sand conditions. Transient wellbore instability developments were tracked by using the visualization tool.

FUTURE WORK:

1. Improve the parallel computing structure to get a better computing speed up.
2. Conduct some large simulations that will reduce the boundary effect with a larger rate of the sample size to the wellbore size and with different rock conditions;
3. Use field/lab data as inputs for case studies under the 2D condition;
4. Step into the 3D case if possible

Predicting Dynamic Barite Sag in Oil Based Drilling Fluids

Tan Nguyen

PREDICTING DYNAMIC BARITE SAG IN OIL BASED DRILLING FLUID

INVESTIGATOR: Tan Nguyen

OBJECTIVE

- Study the effects of oil based drilling fluids rheology on static and dynamic barite sag by using rotational viscometers;
- Experimentally investigate the combined effects of oil base drilling fluids rheology, annular velocity, drill-pipe rotation, eccentricity, and inclination angle on dynamic barite sag;
- Develop mathematical model(s) for predicting dynamic barite sag in Newtonian oil based drilling fluids in horizontal configuration.

SUMMARY

In this study, several methods for evaluating barite sag in two mineral oil-based drilling fluids are examined in a flow loop and by using a rotational viscometer modified by the addition of a sag shoe (Modified Rotational Viscometer, MRV). The results from the MRV show that if the yield stress of drilling fluids is higher than 12 lbf/100ft^2, the fluids can keep barite particles in suspension under static conditions for 15 hours. The combined effects of eccentricity and pipe rotation on dynamic barite sag in oil-based drilling fluids are also described in this study. Flow loop test results indicate that pipe rotation has a greater impact on reducing sag when the pipe is eccentric than when it is concentric.

A fundamental mathematical approach used to analyze the settling of barite particles in shear flow in pipe of Newtonian fluids is presented. A set of four coupled partial differential equations are obtained by applying mass and momentum conservation for solid and liquid phases. Solid concentration in the axial and radial directions as a function of time is calculated by using an explicit numerical method. The proposed model shows a poor prediction of the experimental data. However, after taking into account the effects of fluid viscosity (which is a function of solid concentration), hindering of particles, and critical solid concentration, the modeling results are significantly improved. The relative error between modeling and experimental data after nine minutes of flow is about 12%.

The proposed methodology and results of this study will help us to have a better understanding of barite sag during drilling operations.

PROJECT STATUS

Tasks	Percentage Accomplished
Literature review	100%
Rheology tests	100%
Dynamic tests without pipe rotation with the SSFL	100%
Dynamic tests with pipe rotation with the SSFL	100%
Modifying the LIFL	100%
Dynamic tests with LIFL	100%
Model development	100%
Final report	100%

COMPLETION DATE: July, 2009

Modeling of Thermal Effects on Wellbore Stability

Duc Nguyen

<div align="center">

EXECUTIVE SUMMARY
Modeling of Thermal Effects on Wellbore Stability

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Investigator: Duc Nguyen, TUDRP

Introduction:

Wellbore instability is a costly problem, and is especially challenging in high pressure high temperature wells. Deep and deviated wells are becoming more and more common; one needs to understand the behavior of formation rock in order to control the stability of such wells. The responsible factor is the state of stresses, which is influenced by mechanical (in-situ), hydraulic (pore pressure change), and thermal effects. The purpose of this study is to investigate the effect of temperature on wellbore stability under combined conditions (heat transfer with flowing drilling fluid, heat sources generated by mechanical friction, effect of pore pressure on formation temperature profile).

Objectives:

- Enhance our understanding of the thermal effects on wellbore stability.
- Develop a heat transfer model that takes into account the effect of mechanical friction.
- Create a (thermo-poro-elastic) simulator to predict and analyze wellbore stability problems.
- Determine the effect of some controlling parameters on wellbore stability

Project Status:

Literature review	100 %
Wellbore heat transfer model	100 %
Mechanical friction effect	100 %
Wellbore stability model	100 %
Computer simulator	100 %
Final report	100 %

Conclusions & Findings:

- For wellbore stability analysis, significant uncontrollable parameters that have considerable effects on mud weight window prediction include:
  - ✓ Cohesive strength;
  - ✓ Internal friction angle;
  - ✓ Biot's constant.
  Significant controllable parameters:
  - ✓ Wellbore diameter (hole clearance);
  - ✓ Inclination angle;
  - ✓ Azimuth.
- Induced stresses from pore pressure and formation temperature changes narrow down the operating mud weight window.
- Heating of the formation reduces the chance of wellbore fracture while cooling has the reversed effect.
- Bottomhole temperature in rotary drilling mode can exceed formation temperature in a horizontal well.
- Drilling fluid return temperature seems to have little difference in various operations, and thus may not be a good indication of downhole temperature conditions.
- Circulating fluid has a pronounced effect on formation temperature near the wellbore region, and as a result, influencing the thermally induced stresses.

Recommendations:

- More in-depth study of the effects of thermal related parameters (both controllable and uncontrollable factors.)
- Investigate the interactive effects among the controlling parameters (the analysis of variance in this study reflects the individual effect of each parameter in the absence of other factors.)
- Include the prediction of pore pressure profile in undrained condition (presence of mud cake.)
- Include chemical effect in wellbore stability analysis to produce more accurate prediction for shale formation.
- Compare simulation results with field data.

Cuttings Transport with Foam at Simulated Downhole Conditions- The Effect of Hole Inclination Angle

Jiafu Xu

Cuttings Transport with Foam at Simulated Downhole Conditions –

The Effect of Hole Inclination Angle

INVESTIGATOR: Jiafu Xu

OBJECTIVES:
- Bench top experiments to study the effect of concentration of surfactant and polymer on foam stability;
- Foam characterization experiments and confirm Duan's measurement;
- Cutting Transport experiments to build a database for further analysis;
- A correlation relationship and a computer simulator based on Duan's model to describe cutting transport with foam with inclination angle;

STATUS OF PROJECT:

Mission	Sub Mission	Percentage of Completion
Literature Review		95%
Foam characterization and stability study	Bench top experiments on foam stability study.	100 %
	Foam characterization with FGV	100 %
Cuttings transport experiments with ACTF		70%
Correlation development		10%
Modeling and computer simulator	Model development considering inclination angle	50%
	Computer simulator	30%

RECENT PROGRESS:

- 70% of the cuttings transport tests and rheology tests with Advanced Cuttings Transport Facility (ACTF);
- Modification of Foam Generator and Viscometer (FGV);

FUTURE WORK:

- Cuttings transport experiments with ACTF;
- Maintenance of ACTF;
- Model and computer simulator development;

The Effect of Depth of Cuts and RPM on Mechanical Specific Energy

Sandeep Tammineni

The Effect of Depth of Cut and RPM on Mechanical Specific Energy

INVESTIGATOR: Sandeep Tammineni

SPONSOR: TUDRP

OBJECTIVE:
- To investigate the effects of Depth of Cut and RPM on Mechanical Specific Energy.
- A mathematical model to predict the forces at the PDC cutter and verification of the model with the help of experimental results.

PAST WORK:
- Experiments to determine the effect of depth of cut on MSE under different confining pressures.
- Experiments to determine the effect of RPM on MSE under different confining pressure.
- Mathematical model that relates the cutting force to vertical force.

CURRENT WORK:
- Semi-annual Advisory Board Meeting (ABM) final report.
- Thesis Report.

CONCLUSIONS:
- Mechanical Specific Energy decreases with increase in depth of cut and attains a constant value close to the UCS for both types of rocks.
- In the case of Carthage Marble the MSE decreases above 100 RPM, almost to half at 200 RPM.
- In the case of Indiana Limestone the MSE is nearly constant for RPM in the range of 15- 210.
- Powder-like cuttings were observed for Carthage Marble at RPM higher than 100.
- No visible change in cuttings size is observed for Indiana Limestone at RPM range 15- 210.

PROJECT STATUS:

Literature review	100%
Facility Modification	100%
Single Cutter tests and test data analysis	100%
Model verification	100%
Final Report	100%

Experimental Study on Gelation Phenomena of Synthetic Drilling Fluids

Muzaffer Gokdemir

EXECUTIVE SUMMARY

Experimental Study on Gelation Phenomena of Synthetic Drilling Fluids
Investigator: Gorkem Gokdemir, The University of Tulsa Drilling Research Projects (TUDRP)

The aim of this research is to develop a mathematical model to determine the pressure peaks in the annulus, incorporating the effects of temperature and aging time on gelled structure development of Synthetic Based Mud (SBM). Practical application of the model requires a number of parameters that must be obtained from experiments. Therefore a number of experiments have been conducted for determining the gel strength, non-equilibrium and equilibrium stresses of SBM at different temperature and gelling time values. In the next step the Dynamic Testing Facility (DTF) will then be used to measure the pump pressure at startup after periods of resting. The developed mathematical model will be validated via these experimental results.

Objectives
- To measure the gel strength of SBM with different gelling times and temperatures by using a rheometer.
- To measure the effect of breaking gel strength on pump pressure; this can be determined using the Dynamic Testing Facility (DTF) at TUDRP.
- To provide a hydraulic model, and evaluate and refine the model using experimental results.

Research Plan
The research is divided into two stages:

Stage1: Determining gel strength and time-dependent stress behavior of synthetic based mud at different temperatures and gelling time by using Anton Paar Physica MCR301 Rheometer with different measurement geometries. Dynamic testing facility (DTF) will be used to investigate the pump pressure overshoot in the annulus.

Stage2: A hydraulic model of the annulus that considers the effect of gel strength, temperature and aging time will be developed.

Recent Progress
- Mathematical model for stress equation of SBM as a function of time is developed. A structure kinetic equation which shows transitional behavior or time dependency is used and combined with the yield stress term in this methodology. Then the frictional pressure loss formula will be developed with this model.
- Stress over-shoot test on SBM with seven different temperature values and seven aging times at 0.05 1/s, 5.11 1/s and 10.22 1/s shear rates is conducted to analyze the time effects on stress response.
- Literature review on time-dependent fluid behavior, yield stress phenomena, thixotropic (time dependent) behavior, previous mathematical models of gel-breaking pressures.

Future Work
- Additional stress-overshoot tests will be conducted at previously used aging times and temperatures ranges with different shear rates to confirm the hypothesis of gel strength value and to develop a gel strength model that includes time and temperature effects.
- Dynamic tests for pump start-up pressure will be performed with the DTF by measuring the gel break pressure while circulating non-gelled mud.
- The mathematical model will be enhanced and validated via experimental results.

Deliverables
- Mathematical Model for predicting the gel-breaking pressure along the well trajectory.
- Experimental results of this study and final report.

Modeling and Simulation of Simultaneous Drilling and Under-reaming

Georges Ishak

Modeling and Simulation of Simultaneous Drilling and Underreaming

INVESTIGATOR: Georges Ishak

SPONSOR: TUDRP

OBJECTIVES:
- Implement a numerical model to understand Bottom Hole Assembly (BHA) dynamics
    - ‣ Extract harmonic information
    - ‣ Determine the distribution of the surface weight on bit
    - ‣ Predict drillstring stresses and displacements

CURRENT WORK:

- Calculate the weight on bit and weight on the reamers for different cases of formations for a slick bottom hole assembly with no inclination angle.
- Show the change of the side forces acting on the bit for different inclination angles and weight on bit.
- Model the behavior of a slick assembly on "Abaqus".
- Model the bottom hole assembly adding one stabilizer.

FUTURE WORK
- Developing a useful forcing function to excite the system and determine the forced response.
- Building and verifying a 3-D model of the drillstring.
- Capturing both the static and dynamic response of the system.

DELIVERABLES
- Semi-annual reports.
- Verification of theoretical results using the finite element analysis model ABAQUS.

PROJECT STATUS:

Tasks	2009						2010						
	2	4	6	8	10	12	2	4	6	8	10	12	
Literature Review	▓	▓	▓	×	×	×							30%
Mathematical Modeling			▓	▓	×	×	▓	▓					60%
Computer Simulations				▓	×	×	▓	▓	▓				60%
Field Data Analysis							▓	▓	▓	▓			00%
Final Report										▓	▓	▓	00%

Experimental Study of Torque Reduction Additives for Extended Reach Drilling

Amar Vankadari

Experimental Study of Torque Reduction Additives for Extended Reach Drilling

Investigator: Amar Vankadari, TUDRP

Introduction

In today's world of drilling engineering, extended reach drilling (ERD) has created a revolution in thought and reach. With this change from vertical to highly inclined and horizontal extended reach wells, we face unique challenges in the management of torque. This project is an experimental study to examine and quantify the effects of solid additives on torque reduction. The University of Tulsa Drilling Research Projects (TUDRP) Low Pressure Ambient Temperature (LPAT) flow loop and Small Indoor Flow Loop (SIFL) facilities will be utilized to simulate ERD and perform experiments.

Objectives

- Experimentally determine the effect of solid additives on torque reduction in ERD.
- Experimentally determine the optimum volumetric percentage of solid additives required at various specified drilling conditions.

Summary

This project can be envisaged in three stages, measurement of torque with solid additives and no cuttings and solids additives with and without cuttings. Three drilling parameters, concentration of solid additives, flowrate and RPM are included into the test matrix to simulate practical drilling conditions.

Torque meters have been installed on both LPAT flow loop and SIFL. On LPAT flow loop, a new injection system was redesigned and installed. Accordingly, modifications were carried out on the SIFL, to reduce the variation of torque. Baseline experiments were performed on LPAT flow loop with water as drilling fluid with and without cuttings. It is observed from the results that torque values have increased with the presence of cuttings in the test section. Also, theoretically calculated torque is much less than the actual torque measured from the experiments.

Future Work

- Experiments on solid additives, with and without cuttings on the LPAT and SIFL.
- Develop a model to determine the levels of cuttings as a function of torque. The model will include the effect of the additives.

Project status (completed)

Literature review	40%
Facility Modification	90%
Experiments and test data analysis	10%
Final Report	0%

Deliverables

- Recommendations for better management and reduction of torque under different drilling conditions using solid additives.
- Advisory board meeting Progress Reports and a final report.

Experimental Study and Modeling of Barite Sag un Annular Flow

RESEARCH PROPOSAL

Yahya Hashemian

Experimental Study and Modeling of Barite Sag in Annular Flow

INVESTIGATOR: Yahya Hashemian

SPONSOR: TUDRP

OBJECTIVE:

- Develop a model for barite sag in annular flow to predict the effects of fluid annular velocity, eccentricity, pipe rotation and inclination angle.

- Experimental studying of annular flow to investigate the above effects on barite sag.

SCOPE OF WORK:

- Modeling: To use flow equations for liquid-solid phase in annulus and solve the equations using numerical schemes.

- Experimental study: Modifying the large indoor flow loop available at TUDRP for running experiments on annular flow.

PROPOSED TEST MATRIX:

Annular Velocity (ft/min)	30	50	80	150
RPM	0	20	50	100
Inclination Angle	30	60	75	90
Eccentricity	0	-0.8	0.8	

DELIVERABLES

- Semi-annual advisory board meeting progress report
- Experimental data set
- Modeling
- Final report

PRELIIMINARY TIME TABLE:

Task	2009	2010			2011			2012
	Fall	Spring	Summer	Fall	Spring	Summer	Fall	Spring
Literature Review	▓	▓	▓	▓				
Modeling			▓	▓	▓	▓	▓	
Experiments		▓	▓	▓	▓	▓	▓	
Final Report								▓

Study of Factors Affecting MSE: The Effects of Back Rake and Side Rake Angles

RESEARCH PROPOSAL

Vusal Rajabov

Study of the Factors Affecting MSE: The Effects of Back Rake and Side Rake Angles

INVESTIGATOR: Vusal Rajabov

SPONSOR: TUDRP

PROBLEM STATEMENT:

Since their introduction in the industry, great improvements have been achieved in optimization of PDC drill bit performances in both soft and hard rocks. Regardless of these improvements, the drilling industry still suffers from low ROP. The cutter-rock interaction plays a key role in bit performance. The cutter back rake and side rake angles are among the main parameters affecting the rock cutting process and performance of a bit. The provided study is trying to find the most efficient back rake angles in combination with different side rake angles to find the minimum required energy to cut the Carthage Marble and Mancos Shale rocks under atmospheric and elevated pressures.

OBJECTIVE:
- To develop a mechanistic model that considers the effect of cutter back rake and side rake angles on the PDC cutter performances.
- To study experimentally the effect of cutter back rake and side rake angles on the MSE.

SCOPE OF WORK:
- Theoretical: To provide a mechanistic model that will consider the effect of cutter back rake and side rake angles on cutting performance.
- Experimental: To calculate the MSE of the Cartage Marble and Mancos Shale rocks at different confined pressure cutter back rake and side rake angles.

PRELIMINARY TEST MATRIX:

Back Rake Angle	Side Rake Angle	Confining Pressure	Rock Type
15 deg 20 deg 25 deg 30 deg	0 deg 5 deg 10 deg 20 deg	0 psi 250 psi 500psi	Mancos Shale Carthage Marble

DELIVERABLES:
- Mechanistic Model that considers the effect of cutter back rake and side rake angles on the cutter forces.
- An experimental database on cutter rock interaction.
- Semi annual reports
- A final report and a M.S. thesis

Smear Effect in Casing Drilling- The Effect of Casing Dynamics

RESEARCH PROPOSAL

Duc Nguyen

EXECUTIVE SUMMARY

Smear Effect in Casing Drilling – The Effect of Casing Dynamics

Investigator: Duc Nguyen, TUDRP

Introduction:

Casing Drilling is an emerging technology that helps with reducing drilling cost as well as issues associated with conventional drilling such as lost circulation, well control and borehole stability problems. Among various advantages, lost circulation reduction is probably one of the most beneficial phenomena of casing drilling. However, this effect has not been fully explained nor thoroughly studied. The purpose of this project is to investigate the effect of casing dynamics on the plastering mechanism of drilled solids into the borehole wall, and the relationship of this phenomenon with the reduction of lost circulation problems.

Objectives:

- Provide more thorough understanding of the smearing effect and its connection to lost circulation mitigation.
- Create a dynamic buckling model for casing drilling / narrow annulus drilling application.
- Develop a model for particle mechanics of drilled solids in the wellbore, taking into account the effect of casing dynamics.
- Carry out experiments to investigate the dynamic buckling of casing/drillpipe in a wellbore.

Scope of Work:

- Literature review of casing dynamics and particle mechanics.
- Modeling dynamic buckling of casing under different patterns of snaking motion and whirling motion.
- Modeling particle mechanics of drilled solids inside the wellbore under the effect of casing dynamics.
- Experimental investigation using the buckling facility to measure the axial stresses and lateral contact forces for a buckled pipe in a horizontal section.

Deliverables:

- Advisory Board Meeting progress reports and a final report.
- Mechanistic model of casing dynamics and particle mechanics in narrow annulus drilling.
- Computer simulator based on the developed mechanistic model.

Tentative Time Table:

	2009	2010			2011			2012
	Fall	Spring	Summer	Fall	Spring	Summer	Fall	Spring
Literature review	▓	▓	▓	▓	▓	▓	▓	
Casing Dynamics		▓	▓	▓	▓	▓		
Particles Mechanics						▓	▓	▓
Experimental Investigation				▓	▓	▓		
Computer Model			▓	▓	▓	▓	▓	▓
Final report							▓	▓